A Low-Glycemic Nutritional Fitness Program to Reverse Metabolic Syndrome in Professional Firefighters: Results of a Pilot Study.

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National Institutes of Health Grants R21 NR011077
Emergency Duties and Deaths from Heart Disease among Firefighters in the United States

Stefanos N. Kales, M.D., M.P.H., Elpidoforos S. Soteriades, M.D., Sc.D., Costas A. Christophi, Ph.D., and David C. Christiani, M.D., M.P.H.
Firefighter Fatalities

- Firefighters have twice as many cardiovascular deaths compared to police officers and four times the proportion among emergency medical responders.
Surveying & Assessing Firefighter Fitness & ECGs, The SAFFE Study

The purpose of this 2 year prospective study was to characterize the electrocardiogram (ECG) at rest and exercise ECG in on-duty professional firefighters.

National Institutes of Health Grants R21 NR011077
Firehouse Rotation

Engine 21/Ladder 6/Rescue 1
1229 Jefferson Ave. & Kingsley

Engine 32 /Ladder 5 Quarters
700 Seneca & Swan

Engine1/Ladder 2 Quarters
132 Ellicott & South Division

Engine 34 / Ladder 7
2837 Main St. & Mercer
Methods

- Informed Consent obtained
- Anthropometric measurements
- Actigraph watch for 3 days for objective sleep-wake patterns
- Completed 6 paper pencil surveys
- ECG (Holter) for 24 hours
- Exercise Stress Test
All leads were acquired at a high resolution, 0.05 - 60 Hz.
Surveys

Time Line Follow Back (recall use of alcohol, caffeine, and nicotine)
Epworth Sleepiness Scale
Pittsburgh Sleep Quality Index
Spirituality in Everyday Life
SF-12 Health Survey
Beck Depression Inventory

**EPWORTH SLEEPINESS SCALE**
How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times.

0 = no chance of dozing
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance Of Dozing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td></td>
</tr>
<tr>
<td>Watching TV</td>
<td></td>
</tr>
<tr>
<td>Sitting inactive in a public place (e.g. a theater or a meeting)</td>
<td></td>
</tr>
<tr>
<td>As a passenger in a car for an hour without a break</td>
<td></td>
</tr>
<tr>
<td>Lying down to rest in the afternoon when circumstances permit</td>
<td></td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after a lunch without alcohol</td>
<td></td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in traffic</td>
<td></td>
</tr>
</tbody>
</table>
Fire Apparatus

Fire Engine passes water through hoses to the fire.

The Turntable Ladder is used to gain access to fires occurring at height, where conventional ladders might not reach.

Rescue Unit is a giant toolbox on wheels, designed for technical rescue situations such as car accidents or building collapses.

Engine 21/Ladder 6/Rescue 1
1229 Jefferson Ave. & Kingsley

n=4 firefighters

n=4 firefighters

n=5
Technical Challenges

Loss of electrode contact,
Electrode shift on the diaphoretic torso,
Equipment damage, one Holter unit was crushed during a fire call.
60 cycle artifact.

The six precordial leads (V1-V6) with 60 cycle artifact in lead V3.
Variable Cutoff for abnormal Nonsustained VT >3 consecutive PVCs >100bpm Premature Vent Contract ≥10 or more PVCs per hour LVH SV3 + RaVL >20 mm in women, >23mm in men, Cornell
Heart Rate Trends

24 hr heart rate trend
Sample Characteristics, n=112

<table>
<thead>
<tr>
<th>Variable</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>43.6 ±7.7</td>
</tr>
<tr>
<td>Years as a firefighter</td>
<td>15.5 ±7.0</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>205.5 ±31.3</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>129.3 ±14.9</td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>81.8 ±10.6</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>29.5 ±4.1</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>101.3 ±11.8</td>
</tr>
</tbody>
</table>

The National Fire Protection Association
Survey Results

- Sleep Deprivation
- Over Weight
- Poor Mental Well-being
- Nicotine Use
- Hazardous Drinking
- Depression

Percent Endorsing Each Condition
<table>
<thead>
<tr>
<th>Variable</th>
<th>Firefighters</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average 24h HR (beat/min)</strong></td>
<td>76.6 ±9.9</td>
<td>54-113</td>
</tr>
<tr>
<td>Minimum 24h HR (beat/min)</td>
<td>47.1 ±7.1</td>
<td>29-69</td>
</tr>
<tr>
<td>Maximum 24h HR (beat/min)</td>
<td>142.7 ±21.1</td>
<td>95-209</td>
</tr>
<tr>
<td>QRS duration (msec)</td>
<td>98.5 ±11.1</td>
<td>56-149</td>
</tr>
<tr>
<td>QTc interval (msec)</td>
<td>409.2 ±33</td>
<td>368-540</td>
</tr>
<tr>
<td>IVCD (count)</td>
<td>10 (8.9)</td>
<td>—</td>
</tr>
<tr>
<td>Left bundle branch block</td>
<td>1 (0.9)</td>
<td>—</td>
</tr>
<tr>
<td>NSVT (count)</td>
<td>1 (0.9)</td>
<td>—</td>
</tr>
<tr>
<td>PVC (count)</td>
<td>5 (4.5)</td>
<td>—</td>
</tr>
<tr>
<td>Q waves (count)</td>
<td>3 (2.7)</td>
<td>—</td>
</tr>
<tr>
<td>QRS fragmentation (count)</td>
<td>28 (25)</td>
<td>—</td>
</tr>
<tr>
<td>LVH (count)</td>
<td>4 (3.6)</td>
<td>—</td>
</tr>
<tr>
<td>ST events (count)</td>
<td>14 (13.4)</td>
<td>—</td>
</tr>
<tr>
<td>Heart Rate Variability (rmsSD)</td>
<td>63.9 ±44.3</td>
<td>20-151</td>
</tr>
<tr>
<td>Spatial QRS-T Angle (degrees)</td>
<td>78.1 ±37.3</td>
<td>8-161</td>
</tr>
</tbody>
</table>
Prevalence of High Risk ECG Characteristics

n=112

Number of Firefighters
The **SAFFE** Study: Conclusions

- Sleep problems
- First study to record high resolution ECGs
- Elevated average HR
- Widened QRST angle
“Science … never solves a problem without creating ten more.”

George Bernard Shaw
Firefighter Calendars

New York City Firefighters

FDNY Firefighters

Halifax Firefighters

Houston Firefighters

2008 Calendar of Heroes

2007

2011

2011
Metabolic Syndrome

A combination of disorders that increase the risk of cardiovascular disease and diabetes. National Institute of Health (NIH): 3 of 5 risk factors below:

- Waist Circumference (men > 40, women >35 inches)
- Triglycerides >150mg/dL
- HDL (men<40mg/dL, women<50mg/dL)
- HTN (>130/85 mmHg)
- Fasting Glucose (>100 mg/dL)

average waist circumference is 40.6 in
Purpose

- To define the prevalence of metabolic syndrome among professional firefighters.
- To evaluate the effect of a 12-week low glycemic nutritional fitness program on reversing metabolic syndrome risk factors.
# Measurements for Metabolic Syndrome

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Reference Range</th>
</tr>
</thead>
</table>
| **Body Mass Index (kg/m²)**      | < 18.5 = under weight  
                                   | 18.5-24.9 = normal  
                                   | 25-29.9 = overweight  
                                   | 30-34.9 = obesity class I  
                                   | 35-39.9 = obesity class II  
                                   | ≥ 40 = morbid obesity       |
| **Waist Circumference (inches)** | Men: ≤ 40  
                                   | Women: ≤ 35          |
| **Blood Pressure (mmHg)**        | ≤ 120/80 = normal  
                                   | 121-139/80-89 = pre-hypertension  
                                   | 140-159/90-99 = hypertension class I  
                                   | ≥ 160/100 = hypertension class II |
| **Fasting Blood Glucose (mg/dL)**| 80-110 = normal  
                                   | 111-126 = glucose intolerance  
                                   | > 126 = diabetes mellitus       |
| **Triglycerides (mg/dL)**        | < 150 = normal  
                                   | 150-199 = borderline  
                                   | 200-499 = high  
                                   | ≥ 500 = very high               |
| **High Density Lipoproteins (mg/dL)** | < 40 = not desirable  
                                   | 40-59 = borderline cardio-protective  
                                   | ≥ 60 = cardio-protective        |
## Results, Metabolic Syndrome

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>WC</th>
<th>TG</th>
<th>HDL</th>
<th>BP</th>
<th>FBS</th>
<th>MetS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firefighters</td>
<td>75</td>
<td>48.0</td>
<td>29.3</td>
<td>52.0*</td>
<td>53.3*</td>
<td>52.0*</td>
<td>46.7*</td>
</tr>
<tr>
<td>General pop</td>
<td>3423</td>
<td>48.0</td>
<td>31.2</td>
<td>24.7</td>
<td>39.5</td>
<td>38.6</td>
<td>34.0</td>
</tr>
</tbody>
</table>

*p<0.05

Ervin R. *Prevalence of metabolic syndrome among adults 20 years of age and over, by sex, age, race and ethnicity, and body mass index: United States, 2003-2006.* Centers for Disease Control and Prevention, National Center for Health Statistics; 2009.
One platoon of firefighters, n=10.

A professional training team (personal trainer, nurse and physician) visited the firehouse weekly to provide:

- Group lecture about nutrition and fitness,
- A 30 minute training class (e.g., yoga), and
- Evaluation of individual progress.
12 week low-glycemic nutritional fitness program

<table>
<thead>
<tr>
<th>Component</th>
<th>Time frame</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>Before starting</td>
<td>Anthropometrics and physiologic measurements obtained for all subjects at three time intervals by the same exercise instructor.</td>
</tr>
<tr>
<td>Mid-program</td>
<td>After 6 weeks</td>
<td></td>
</tr>
<tr>
<td>End of program</td>
<td>After 12 weeks</td>
<td></td>
</tr>
<tr>
<td>Diet and Nutrition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal planning</td>
<td>W1</td>
<td>Breakfast was replaced by a supervised meal throughout the program, as well as educating subjects about a variety of food topics, and supervised selection of healthy foods.</td>
</tr>
<tr>
<td>Healthy eating</td>
<td>W2, W10</td>
<td></td>
</tr>
<tr>
<td>Meal replacement</td>
<td>W1-to-W12</td>
<td></td>
</tr>
<tr>
<td>Meal education</td>
<td>W3-to-W9</td>
<td></td>
</tr>
<tr>
<td>Supervised Exercise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workout clearance</td>
<td>W1</td>
<td>After cleared out for exercise by a physician, subjects went through a scheduled program of various sessions for target-specific trainings. Basic knowledge about stretching, exercise intensity, and heart rate targeting given.</td>
</tr>
<tr>
<td>Exercise education</td>
<td>W2</td>
<td></td>
</tr>
<tr>
<td>Weight training</td>
<td>W3</td>
<td></td>
</tr>
<tr>
<td>Cardiac exercise</td>
<td>W4</td>
<td></td>
</tr>
<tr>
<td>Resistance training</td>
<td>W5</td>
<td></td>
</tr>
<tr>
<td>Muscle balance</td>
<td>W6</td>
<td></td>
</tr>
<tr>
<td>Fat burning</td>
<td>W9</td>
<td></td>
</tr>
<tr>
<td>Life-style training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eating out</td>
<td>W10</td>
<td>Subjects encouraged achieving 60-90min of daily mild-to-moderate activity, Pedometers to encourage walking and a diary of daily consumption and weekly weight given as well.</td>
</tr>
<tr>
<td>Activity</td>
<td>W1-to-W12</td>
<td></td>
</tr>
<tr>
<td>Yoga</td>
<td>W8</td>
<td></td>
</tr>
<tr>
<td>Self evaluation</td>
<td>W1-to-W12</td>
<td></td>
</tr>
</tbody>
</table>

**ABS ON THE BALL**

Crunches on the Ball: Rectus abdominis exercises, activate the core,提高 your core strength. Take a stable exercise ball under your hips, lower back, and back. The wider the distance between your hands, the wider you will work to balance. Lift your midline down to your chest. Keep sequential roll up, feet through the back of the neck, keeping spinning (tennis ball), and pulling the navel to the lower back and hips remain touching the ground.
Reading Food Labels 101

a. Calories (per serving) Remember, if you eat 2 servings you are actually getting twice the calories, fat, carbs etc. Determine your serving size first!
b. Total Carbohydrates (4 calories/g) = Complex Carbs (major energy source)
   + Fiber + Sugar

Challenging the Routine......
What to think about when your smooth sailing diet plan hits the undertow of everyday life.
• You’ve really adapted well to your diet plan and after several weeks of following a strict, but nutritious diet, you’re invited out to dinner to

Healthier fast food at burger chains
Figuring out healthier options at your favorite fast food burger chain can be tricky. A typical meal at a burger joint consists of a "sandwich", some fries and a drink, which can quickly come in at over 1700 calories for something like Burger King's Triple Whopper with a
Most (70%) had metabolic syndrome at the baseline and this prevalence decreased significantly after 12 weeks to 30%, p=0.02.
Case Study

- A 55 year old:
- Waist Circumference 48 to 42 inches
- Systolic BP 152-132
- Fasting Blood Sugar 135-105
"A lot of guys at other firehouses are asking us about the diet, a couple of guys use to call me sugar ray and now they call me no sugar ray.

I went to my doctor for my yearly physical and she couldn't believe how much weight I lost and how good all my blood work was. So she called my cardiologist and took me off plavix and crestor, also my pulmonary function test results all improved!

So although it was tough at times I think it was well worth it and I feel a hell of alot better than I did before the study started and think it is worth pursuing on the larger scale with the rest of the department. Thank you. THE BIGGEST LOSER".
Conclusion

The prevalence of metabolic syndrome is higher among professional firefighters compared to general population

A 12-week low glycemic nutritional fitness program can significantly decrease the prevalence of risk factors.

Social cohesion among the platoon had a beneficial effect on health and well-being.
A Low-Glycemic Nutritional Fitness Program to Reverse Metabolic Syndrome in Professional Firefighters

Results of a Pilot Study

Mary G. Carey, PhD, RN; Salah S. Al-Zaiti, MS, RN; Limei M. Liao, MS, RN; Heather N. Martin, BS, RN; Rachael A. Butler, BS
SAFFE Study

Excellence Through Teamwork, Buffalo Fire Department

TEAM

- Mary Carey, Primary Investigator
- Salah Al-Zaiti, PhD student
- Rachael Butler, PhD student
- Limei Liao, MS/PhD Student
- Sherri McMullen, PhD Student
- Heather Martin, UG student
Continental Flight 3407
February 13, 2009

- A plane from Newark stalled less than a mile from the Buffalo runway and crashed into a house in Clarence Center.
- 50 people were killed including the two pilots, two flight attendants, 45 passengers (including one off-duty pilot), and one person in the house.
Line of Duty Deaths
August 24, 2009


Reports from the scene indicated the two firefighters may have fallen through the first floor while searching for a civilian victim.

"Our hearts are broken right now." McCarthy leaves behind his wife, three children and a 6-month-old grandchild. Croom leaves behind a 9-month-old child and a fiancée.
A Low-Glycemic Nutritional Fitness Program to Reverse Metabolic Syndrome in Professional Firefighters: Results of a Pilot Study.

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